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This second year of the grant has been a year of consolidation and staging for the continuing research. The advances made at the end of last year, in particular the proof-of-concept of solid state etalone, are now going through the process of testing and validating the findings made with the prototype devices. Thus far, all of the benchmarks of the electrooptic etalon behavior can be repeated, and we have also found some new characteristics inherent to the device and its operation. For instance, in the non-linearity stage of measurements, it has been found that the reflective coatings are extremely sensitive to the presence of molsture in air. This effect seems to be enhanced by the existence of the electric fields (elrea 20 KV/cm) necessary for the operation of the electrooptic etalon. Operation in a vacuum, or in a controlled atmosphere are the obvious solutions, with the latter being the preferred choice since it preserves the ideal of a lightweight field device. Recoating of the test etalon was necessary.

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AFOSR-89-0316

Interim Report: Second Year

This second year of the grant has been a year of consolidation and staging for the continuing research. The advances made at the end of last year, in particular the proof-of-concept of solid state etalons, are now going through the process of testing and validating the findings made with the prototype devices. Thus far, all of the benchmarks of the electrooptic etalon behavior can be repeated, and we have also found some new characteristics inherent to the device and its operation. For instance, in the non-linearity stage of measurements, it has been found that the reflective coatings are extremely sensitive to the presence of moisture in air. This effect seems to be enhanced by the existence of the electric fields (circa 20 KV/cm) necessary for the operation of the electrooptic etalon. Operation in a vacuum, or in a controlled atmosphere are the obvious solutions, with the latter being the preferred choice since it preserves the ideal of a lightweight field device. Recoating of the test etalon was necessary.

The required equipment, for the continued development of the Double Etalcn Modulator (DEM) into its first step as a laboratory instrument, has been recently received and is now in the process of being incorporated into the prototype. More machine shop work is required for its completion and it will begin shortly. Simultaneous to the experimental development of the DEM, a theoretical study into the many spectroscopic capabilities of this instrument is being carried out. This theoretical study has taken two directions. The first analyses the spectral and spatial properties of the DEM as a high resolution filter, while the second has partially investigated the limiting case of the three reflecting layer device and its general (optical and spectroscopic) properties. Manuscripts on these topics are in preparation.

The laboratory experimental work is, at the time of this writing, at a standstill due to construction and renovation of our laboratory space by the University. This process, as disruptive as it is, will result in a net gain since our darkroom space will be more than doubled in area, and will make it possible to conduct our experimental investigations in more appropriate quarters. This expansion of the laboratory space is a recognition of the University of our research and its place in the education of graduate students.

The field instrument at Poker Flat, AK has just begun the 1990/1991 observing season after extensive maintenance and upgrade this summer. This two-channel device is now operating at peak efficiency and will receive its four-channel adaptation sometime this winter after the four-channel section is checked-out in the laboratory. Some of the

data obtained with this instrument have become part of a global model of thermosphere winds as the one auroral zone station. It is satisfying to know that the investment of effort and time involved in the operation of this station, in the auroral zone, is now bringing large dividends. The 1989/1990 season data set is undergoing its reduction phase, and analysis is not far behind. These data contain some of the best molecular emission (Mesosphere and Lower Thermosphere) MALT measurements anywhere and, with the help of our newly developed robust code, will provide new insights of the behavior of this region at the auroral zone.

The AFOSR funding of our teleautonomous investigations is also providing returns beyond the original expectations. Besides the Poker Flat experiment, where the concepts were designed and applied, these concepts have made it possible to deploy an autonomous experiment (NSF funded) at the South Pole, Antarctica station which has successfully operated for two years with only a yearly visit by the investigators. Further, another similar project will be installed this winter at Mount John, Tekapo, New Zealand, which will take full advantage of the teleautonomous capabilities we have developed under AFOSR. The teleautonomous option we now have available makes it possible to install such experiments unmanned (i.e., without the need of extensively trained personnel to operate it) far away from the home base, since the actual operation of the experiment is governed from the home bases (via telephone lines). These teleautonomous systems have the advantages of being operated from far away, having the validity of the data checked in real-time by experienced investigators, and requiring no on-site trained personnel.

The personnel associated with this AFOSR grant, during its second year, have been as follows:

Senior Personnel:

Dr. G. Hernandez	(Washington)
Dr. R. W. Smith	(Alaska)
Dr. K. C. Clark	(Washington)

Junior Personnel:

Dr. G. Price	(Alaska, Post-Doctoral)
Mr. J. Conner	(Alaska, Graduate student)
Mr. J. Minow	(Alaska, Graduate student)
Mr. W. Schuls	(Washington, Graduate student)
Mr. H. Xu	(Washington, Graduate student)

Publications during the second year of this grant:

Hernandes G., R. W. Smith and K. C. Clark. Global thermospheric dynamics and thermodynamics from South Pole, Antarctica. *Antarctic Journal of the U. S.*, 14, in press, (1990).

Hernandes, G., R. W. Smith, R. G. Roble, J. Gress and K. C. Clark. Thermospheric dynamics at the South Pole. *Geophys. Res. Lett.*, 17, 1255-1258, (1990).

Hernandes, G., R. W. Smith, S. D. Kauffman and K. C. Clark. South Pole mesospheric and lower-thermospheric dynamics. *Antarctic Journal of the U. S.*, 15, submitted, (1990).

Hernandes, G., F. G. McCormac and R. W. Smith. Austral thermospheric wind circulation and IMF orientation. *J. Geophys. Res.*, 95, in press, (1990).

Hedin, A. E., M. A. Biondi, R. G. Burnside, G. Hernandes, R. M. Johnson, T. L. Killeen, C. Mazaudier, J. W. Meriwether, J. E. Salah, R. J. Sica, R. W. Smith, N. W. Spencer, V. B. Wickwar and T. S. Virdi. Revised global model of thermosphere winds using satellite and ground-based observations. *J. Geophys. Res.*, 95, submitted, (1990).

Presentations associated with the grant investigations:

Interaction between the lower and upper atmosphere. Department of Physics, University of Canterbury, Christchurch, NZ. November 1989.

Thermospheric Dynamics at 90° South. (with R. W. Smith, K. C. Clark and R. G. Roble). American Geophysical Union, Fall Meeting, San Francisco, CA. December 1989.

TIGCM simulations of thermospheric dynamics in the Southern Hemisphere Polar Cap and comparisons with South Pole Fabry-Perot Spectrometer measurements. (with R. G. Roble, R. W. Smith and K. C. Clark). American Geophysical Union, Fall Meeting, San Francisco, CA. December 1989.